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Financial Market Taxation and International Capital Flows

Prepared By Mario I. Blejer

Approved by Vito Tanzi

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1. Introduction

There is extensive literature on the various relationships between inflation, interest rates, and exchange rates and on their interconnections in an integrated international capital market. Most of this literature, however, has not considered in detail the impact of taxes and the effects that differential taxation across countries have on international financial markets.

In a world without taxes, theory suggests the simultaneous holding of the Fisher effect (linking domestic inflation and interest rates), purchasing power parity (relating the exchange rate to domestic and foreign inflation), and interest rate parity (linking domestic and foreign interest rates). 1/ The introduction of taxes tends, in general, to prevent the simultaneous fulfillment of these three propositions. The nature and direction of the departures, as well as their consequences, can be traced to the type of taxes imposed and to their relationships across countries. However, most of the existing analysis that has specifically considered taxation has centered on the effects of taxes on the Fisher equation within the framework of a closed economy. Darby (1975) and Tanzi (1976) modified the Fisher relationship and established that, when taxes are considered, nominal interest rates will tend to be affected more than proportionally by changes in the expected rate of inflation. 2/ Although Makin (1978) extended the treatment by Tanzi and Darby to an open economy, most of the empirical and theoretical literature on interest rate parity and on purchasing power parity has ignored the effects of taxes on international financial equilibrium. The omission of taxes from the analysis can be justified by assuming that capital flows are not affected by taxation or, alternatively, that taxes affect both sides

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1/ See, for example, Roll and Solnik (1973).

2/ Extensions of the Darby-Tanzi treatment are presented by Gandolfi (1982) and Miles (forthcoming). For a recent empirical implementation supporting the revised Fisher effect, see Peek (1982).

of interest rate parity proportionally. However, tax practices in Western countries appear to contradict both of these implicit assumptions. 1/

The importance of differences in taxation practices for the analysis of international financial relationships and some of the implications of incorporating tax factors in the context of an open economy are studied by Levi (1977). 2/ He considers the tax rules of Canada and of the United States regarding foreign-generated income and also the tax treatment of capital gains. His analysis proves that differential taxation plays a central role in explaining deviations from pretax interest rate parity. Levi's study also sheds light on the motivation for what seems, in the absence of tax factors, "abnormal" capital movements such as two-way capital flows.

In a related paper, Hartman (1979) added to the analysis the effects of inflation. He is particularly concerned with the effects of different tax arrangements applying to income generated domestically and to income generated abroad. In his model, taxation leads to the reallocation of real capital stock across countries.

Other recent contributions in this area include Tanzi and Blejer (1982), in which tax considerations are used to explain capital movements between developing and developed countries and Ben-Zion and Weinblatt (1982), where it is shown that tax differentials may provide a significant incentive for short-term capital flows that may affect real interest and real exchange rates. Similar non-neutralities arising from variations in the rate of inflation are obtained by Howard and Johnson (1982). They explain those effects as arising from the taxation of nominal instead of real interest income.

These contributions are indicative of the importance of considering taxes specifically in the context of open and integrated economies. In the next section, these elements are incorporated into a unified analytical framework that deals with the interactions between the modified Fisher effect, purchasing power parity, and interest rate parity and provides a starting point for the study of the implications of alternative assumptions about the tax treatment of financial instruments.

2. The analytical framework

To assess the nature of the non-neutralities arising from alternative tax treatments of financial assets, we consider in this section a simple

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1/ The tax practices of major industrial countries with respect to interest incomes and payments, as well as dividends and capital gains (including foreign exchange gains), are very different, and it is difficult to generalize regarding their points of contact and differences. For a review, see Modi (1982).

2/ See Ben-Zion (1982) for a survey of the literature dealing with the effects of taxation on the international capital market.

analytical framework that will allow us to evaluate the conditions under which these non-neutralities arise, as well as their expected consequences and implications. Within this framework, a number of simplifying assumptions are made in order to center the discussion around the main consequence that taxation has on domestic capital markets as well as on international capital movements. We assume a two-country setting where none of the two countries is large with respect to the other. We assume that the whole spectrum of financial assets available in each country can be subsumed by a characteristic asset, called here a "bond," and that these bonds are perfect substitutes across countries in the sense that they are identical in all respects except for the currency of denomination. This assumption rules out the presence of country-specific financial risks, with the exception of differential exchange risks. However, in order to concentrate on the effects of taxation, we will not consider here the role of exchange risk premia. This is done by assuming that all operations can be covered in the forward exchange market or, alternatively, that expectations about the future course of the exchange rate are held with perfect certainty. 1/ We also assume that marginal tax rates can be described by a single characteristic rate that applies, in each country, to the characteristic financial asset described above. Finally, the actual and expected rates of inflation are taken as exogenous and transaction costs are ignored.

The following notation is used throughout this section:

i_A = nominal interest rate on country A bonds

i_B = nominal interest rate on country B bonds

π_a = expected rate of inflation in country A

π_b = expected rate of inflation in country B

t_a = marginal tax rate on interest income in country A

t_b = marginal tax rate on interest income in country B

r_a^* = real after-tax rate of interest in country A 2/

r_b^* = real after-tax rate of interest in country B

R^A = nominal after-tax rate of return on country A bonds for residents of country A

1/ When both alternative assumptions coincide, there is no risk premium in the forward exchange market, that is, the forward rate and the expected future exchange rate are the same.

2/ The after-tax real rate of interest is defined as $r^* = (1-t)i-\pi$. Since π is the expected rate of inflation, r^* refers to the ex ante or expected real rate of return.

R_B^A = nominal after-tax rate of return on country B bonds for residents of country A

R^B = nominal after-tax rate of return on country B bonds for residents of country B

R_A^B = nominal after-tax rate of return on country A bonds for residents of country B

e = expected rate of devaluation 1/

Regarding the structure of taxation, three specific assumptions are made: (a) tax treaties assure that residents of each country pay taxes only in their own country, (b) the same tax rate applies to interest income generated by domestic and by foreign instruments, and (c) capital gains are not taxed in any of the two countries. These three assumptions are made here in order to limit the number of cases discussed. However, the impact of their relaxation can be easily analyzed within the same framework.

The two building blocks of the analysis are the Fisher equation and the interest rate parity hypothesis. Although they are reduced forms derived from unspecified behavorial relationships, they are widely taken as a representation of equilibrium conditions consistent with a variety of adjustment models.

Since nominal interest is fully taxed, but there is no taxation on capital gains, the Fisher equation, as modified by Tanzi (1976) and Darby (1975), indicates that expected inflation is bound to affect the nominal interest rate more than proportionally in order to leave the real after-tax rate of return unchanged:

$$(1) \quad i_A = (r_a^* + \pi_a)/(1-t_a)$$

$$(2) \quad i_B = (r_b^* + \pi_b)/(1-t_b)$$

In the open economy, however, domestic interest rates may be affected also by the level of foreign rates, because they are interconnected across countries by the interest rate parity condition. If there are no interferences to the free international flow of capital, portfolio considerations require that

$$(3) \quad R^A = R_B^A$$

$$(4) \quad R^B = R_A^B$$

1/ The exchange rate is expressed in terms of units of currency A per unit of currency B. Therefore, e stands for the expected percentage change of the value of currency A in terms of currency B.

Equations (3) and (4) indicate that, in equilibrium, the after-tax nominal returns of domestic and foreign assets should be equal within each country.

The third element, closing the system formed by equations (1) through (4), is the exchange rate rule. We will postulate here two alternative patterns of exchange rate behavior: (a) the exchange rate follows purchasing power parity, and (b) the exchange rate adjusts in order to ensure the fulfillment of the interest rate parity conditions. 1/

The analysis is conducted under two different assumptions about the tax treatment of gains and losses arising from foreign currency transactions. First, it is assumed that all exchange gains and losses are treated as regular revenue and therefore are subjected to the same tax treatment (i.e., t_a and t_b apply to exchange gains and losses as well as to interest income). Second, it is assumed that exchange gains and losses are taxed at a lower rate than interest income. We will also consider the case in which an additional asymmetry arises when tax deductions for exchange losses are fully claimed while exchange gains are effectively tax exempt owing to widespread tax evasion.

a. Equal tax treatment of interest income and of foreign exchange transactions 2/

Considering first the case in which foreign exchange gains and losses are treated as regular revenue for tax purposes, portfolio equilibrium, as expressed in equations (3) and (4), becomes

$$(5)\quad i_A(1-t_a) = (i_B+e)(1-t_a)$$

$$(6)\quad i_B(1-t_b) = (i_A-e)(1-t_b)$$

1/ The first assumption is based on the premise that the volume of trade and commodity prices are the main determinants of exchange rates even in the short run, while the second considers the capital account as the main force driving exchange rates.

2/ Japan, the Netherlands, and some other industrial countries do not distinguish for tax purposes between regular income and exchange gains. The United States, Canada, and the United Kingdom apply rates of capital gains, and therefore different from income tax rates, to foreign exchange transactions. The assumption of this subsection is, therefore, more appropriate for the first group of countries while that of the next section is relevant for the second. An additional distinction refers to the timing of taxation. While most countries tax foreign exchange gains and losses when they are realized, the United States, Japan, Canada, and the United Kingdom also tax accrued gains and losses. In the Federal Republic of Germany, unrealized gains are not taxable until realized wherever unrealized losses are deductible when incurred.

(1) Under purchasing power parity, the rate of change of the exchange rate is determined by the differential rate of inflation and, therefore, the expected rate of devaluation will follow:

$$(7) \quad e = \pi_a - \pi_b$$

Using equations (1), (2), and (7), the interest-parity conditions as represented by equations (5) and (6) require

$$(8) \quad (r_a^* + t_a\pi_a)/(1-t_a) = (r_b^* + t_b\pi_b)/(1-t_b)$$

Clearly, unless $t_a = t_b$ and $\pi_a = \pi_b$, the simultaneous emergence of purchasing power parity, interest rate parity, and the revised Fisher relationship will imply different real rates of interest across countries. Consider an initial equilibrium position in which $t_a = t_b$, $\pi_a = \pi_b$, and $r_a^* = r_b^*$ (and, therefore, $i_A = i_B$ and $e = 0$). If the income tax rate in country A, t_a, is now increased above t_b, this will result in a higher after-tax nominal return on country A's bonds for residents of both countries. The difference in relative return is 1/

$$(9) \quad R^A - R_B^A = [(1-t_a)r_a^* - (1-t_a)r_b^*]/(1-t_b) + t_a(\pi_a-\pi_b) + [(t_a-t_b)/(1-t_b)]\pi_b > 0$$

$$(10) \quad R_A^B - R^B = [(1-t_b)r_a^* - (1-t_a)r_b^*]/(1-t_a) + t_b(\pi_a-\pi_b) + [(t_a-t_b)/(1-t_a)]\pi_a > 0$$

The above differentials indicate that the increase in the rate of interest income tax in country A creates an incentive for capital flows from the lower (B) to the higher (A) income tax country. These flows will result in a reduction in the after-tax real interest rate of country A and an increase in the rate in country B. Equilibrium will be restored when real rates have changed enough to satisfy 2/

$$(11) \quad r_a^* = [(1-t_a)/(1-t_b)]r_b^* - [(t_a-t_b)/(1-t_b)]\pi_b$$

The transfer of capital and the changes in real interest rates will be larger, the higher is the difference between tax rates and the higher the (equal across countries) rates of inflation. Furthermore, from equations (9) and (10) it is clear that, under differential taxation, an equal increase in the rate of expected inflation in both countries will not be neutral with respect to the level of real interest rates but will tend to reduce the real interest rate in the high-tax country and reduce it in the low-tax country.

From equations (9) and (10), we also learn that differential rates of inflation give rise to capital flows, even if the rates of income tax

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1/ From equations (1), (2), (4), and (5).

2/ Replacing r_a^* in equations (9) and (10) by the equilibrium value in equation (11) results in $R^A = R_B^A$ and $R^B = R_A^B$.

across countries are identical. An increase of π_a and π_b raises the expected rate of devaluation according to purchasing power parity and, setting $t_a = t_b$ we have $R^A > R^A_B$ and $R^B_A > R^B$, inducing capital flows from country B to country A. Thus, the real rate of interest falls in the higher-inflation country (A) and increases in the lower-inflation one (B). Equilibrium is restored as the difference between real rates fulfills:

$$(12) \quad r^*_b - r^*_a = t_j(\pi_a - \pi_b) \qquad j = a,b$$

Clearly, the differential in real returns will be larger, the larger is the differential in expected inflation rates and the higher the common rate of income tax. However, the extent to which r^*_a falls and r^*_b increases, as well as the magnitude of the capital flows, are functions of the elasticities of the capital flows to relative returns in each country.

(2) If the exchange rate is determined by the interest parity condition, its rate of change, as obtained from equations (1), (2), (5), and (6), is

$$(13) \quad e = [(1-t_b)(r^*_a+\pi_a) - (1-t_a)(r^*_b + \pi_b)]/[(1-t_a)(1-t_b)]$$

Equation (13) indicates that for equal after-tax real interest rates, the exchange rate that preserves portfolio equilibrium will generally depart from purchasing power parity if rates of taxation and/or rates of inflation differ across countries. If $r^*_a = r^*_b$, equation (13) can be rewritten as

$$(13') \quad e = [(t_a-t_b)/(1-t_a)(1-t_b)]r^*_j + (1-t_a)^{-1}\pi_a - (1-t_b)^{-1}\pi_b \quad j = a,b$$

When both countries experience the same rate of inflation, equation (13') becomes

$$(13'') \quad e = [(t_a-t_b)/(1-t_a)(1-t_b)]\,(r^*_j+\pi_j) \quad j = a,b$$

indicating that, even if rates of inflation are identical, the exchange rate will devalue in the high-tax country. 1/ The extent of the exchange rate devaluation will depend on the level of (equal) inflation and real interest rates as well as on the difference between tax rates.

From equation (13') we also observe that equality of tax rates does not eliminate the non-neutrality with respect to the exchange rate. In the presence of differential inflation and with $t_a = t_b$, the equilibrating exchange rate is

$$e = (1-t_j)^{-1}(\pi_a - \pi_b) \qquad j = a,b$$

1/ Unless r^*_j or π_j are negative.

Thus, if $\pi_a > \pi_b$, the exchange rate depreciates more than conventional purchasing power parity, with the extent of the departure being inversely proportional to the rate of interest income tax.

In general, for $\pi_a \neq \pi_b$ and $t_a \neq t_b$, the exchange rate may depreciate more or less than indicated by purchasing power parity. However, e will vary less (or be exactly equal) than implied by purchasing power parity only when the higher-inflation country has the lower tax rate. 1/ As a whole, for given changes in inflationary expectations, taxation will lead to an exchange rate that displays more variability than under purchasing power parity, and variability will be larger, the higher are the rates of taxation in both countries.

b. Differential tax treatment of interest income and foreign exchange transactions

We consider now the case in which interest income is taxed at a higher rate than foreign exchange gains and losses. For simplicity, we normalize the tax rate on exchange gains to zero; however, the conclusions apply to all the cases where this rate is lower than the regular interest income tax. Given this assumption, the interest parity conditions, as expressed in equations (3) and (4), result in

$$(14) \quad i_A(1-t_a) = i_B(1-t_a) + e$$

$$(15) \quad i_B(1-t_b) = i_A(1-t_b) - e$$

Once again, in order to evaluate the effects of taxation on the standard equilibrium propositions, the two alternative exchange rate rules should be imposed.

(1) Purchasing power parity. Imposing $e = \pi_a - \pi_b$ on equations (14) and (15) and substituting equations (1) and (2) into those equations, the difference between domestic and foreign yields in each country that would give rise to capital flows can be written as follows:

$$(16) \quad R^A - R^A_B = [(1-t_b)r^*_a - (1-t_a)r^*_b + (t_a-t_b)\pi_b](1-t_b)^{-1}$$

$$(17) \quad R^B_A - R^B = [(1-t_b)r^*_a - (1-t_a)r^*_b + (t_a-t_b)\pi_a](1-t_a)^{-1}$$

Equations (16) and (17) indicate that, in the presence of differential taxation ($t_a \neq t_b$), the Fisher relationship and purchasing power parity are not consistent with the absence of capital flows or with the simulta-

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1/ The condition for the exchange rate to follow purchasing power parity (i.e., $e = \pi_a - \pi_b$ in equation (13')) is that $r^*_j = [t_b(1-t_a)\pi_b - t_a(1-t_b)\pi_a]/(t_a-t_b)$. For a positive real after-tax interest rate, if $t_a > t_b$, $r^*_j > 0$ requires $\pi_b > \pi_a$.

neous holding of interest rate parity in both countries unless both are experiencing the same rate of inflation. Consider, for example, an initial equilibrium position with $t_a = t_b$ and $\pi_a > \pi_b$. This implies a higher nominal interest rate in the higher-inflation country ($i_A > i_B$), the difference matched by an equivalent devaluation. Therefore, real after-tax interest rates are equalized ($r_a^* = r_b^*$), and parity conditions hold. Assume now an increase in t_a such as $t_a > t_b$. Clearly, incentives for capital flows from country B to country A are generated in both countries ($R^A > R_B^A$ and $R_A^B > R^B$), since equations (16) and (17) become

$$(16') \quad R_A - R_B^A = [(t_a - t_b)/(1-t_b)](r_j^* + \pi_b) \qquad j = a,b$$

$$(17') \quad R_A^B - R^B = [(t_a - t_b)/(1-t_a)](r_j^* + \pi_a) \qquad j = a,b$$

The capital flow generated by the tax differential tends to depress the real interest rate of the high-tax country and to raise that of the low-tax country. To satisfy parity conditions in country A, we observe, from equation (16), that the new level of real after-tax interest rate in that country has to fulfill

$$(18) \quad r_a^* = [(1-t_a)r_b^* - (t_a - t_b)\pi_b](1-t_b)^{-1}$$

However, given $\pi_a > \pi_b$, the volume of capital flows, and the consequent change in real interest rates, that equalize domestic and foreign returns for residents in country A will not be sufficient to eliminate the returns differential for residents of country B. From equation (17), we observe that $R^B = R_A^B$ when

$$(19) \quad r_b^* = [(1-t_a)r_b^* - (t_a - t_b)\pi_a](1-t_b)^{-1}$$

If, however, capital flows from country B to country A to satisfy equation (19)--instead of equation (18)--an inverse incentive would arise in country A, since the lower relative level of r_a^* would imply $R^A < R_B^A$.

Thus, the nonharmonization of taxes (across countries and domestically in terms of income and exchange gains taxes) gives rise, in the presence of purchasing power parity and with differential inflation, to incentives for two-way capital flows of the nature discussed by Levi (1977). The new equilibrium position requires r_a^* to fall relative to r_b^* by more than the reduction indicated by equation (18) but by less than that implied by equation (19), with capital flows in both directions and offsetting each other. Notice that in the example above, two-way capital flows arise from an equilibrium in which capital is exported from both countries ($R_A < R_B^A$ and $R_B < R_A^B$). Assuming $\pi_a < \pi_b$, the new equilibrium position will induce capital imports in both countries ($R_A > R_B^A$ and $R_B > R_A^B$). However, in both cases, the real rate of interest in the high-tax country has to fall and the real rate of interest in the low-tax country has to increase in order to restore equilibrium. Moreover, when $\pi_a = \pi_b$ and therefore equations (18) and (19) are identical, ensuring that two-way capital flows do not take place, the unidirectional capital flows arising

from differential taxation result in the same type of relationship between relative taxation and real interest rates: the high-tax country will, in equilibrium, have a lower real after-tax interest rate.

(2) When the exchange rate adjusts to maintain interest parity, the variation required to equalize, within country A, the returns on domestic and foreign bonds is, from equation (14)

$$(20) \quad e = [(1-t_b)r_a^* - (1-t_a)r_b^* - (1-t_a)\pi_b](1-t_b)^{-1} + \pi_a$$

However, from equation (15), interest parity in country B requires

$$(21) \quad e = [(1-t_b)r_a^* - (1-t_a)r_b^* + (1-t_b)\pi_a](1-t_a)^{-1} - \pi_b$$

Two observations can be made from equations (20) and (21). As in the case of symmetric taxation of interest and exchange gains, the exchange rate will depart more from purchasing power parity the larger the differences between taxes across countries. In addition, it is clear that even when inflation rates are equal, differential taxation will induce capital flows and changes in real interest rates. That is so because unless $t_a = t_b$, equations (20) and (21) cannot hold simultaneously for $r_a^* = r_b^*$. 1/

Assuming again an initial equilibrium where $r_a^* = r_b^*$ and $t_a = t_b$, the Fisher effect, interest rate parity, and purchasing power parity will hold, regardless of the relative rates of inflation. If t_a is set higher than t_b, the exchange rate will, according to both equations (20) and (21), devalue more (or appreciate less) than purchasing power parity. Assuming that the exchange rate adjusts according to equation (20), we replace its value in equations (14) and (15), and, using equations (1) and (2) we obtain

$$(22) \quad R^A - R_B^A = 0$$

$$(23) \quad R_A^B - R^B = [(t_a-t_b)^2/(1-t_a)(1-t_b)]r_j^* + (t_a-t_b)[\pi_a(1-t_a)^{-1} - \pi_b(1-t_b)^{-1}] \qquad j = a,b$$

Thus, the exchange rate change required to preserve portfolio equilibrium in country A does not maintain interest parity in country B as long as $t_a \neq t_b$. If $\pi_a > \pi_b$, the returns on foreign investments for residents

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1/ For $r_a^* = r_b^*$ and $\pi_a = \pi_b$, equations (20) and (21) result in

$$(20') \quad e = [(t_a-t_b)/(1-t_b)](r_j^* + \pi_j) \qquad j = a,b$$

$$(21') \quad e = [(t_a-t_b)/(1-t_a)](r_j^* + \pi_j) \qquad j = a,b$$

Clearly, unless $t_a = t_b$, the exchange rate change required by equation (20') differs from that required by equation (21').

in country B are higher than the returns on domestic investments, and capital will flow from country B to country A, reducing r_a^* and increasing r_b^* until incentives for portfolio shifts in country B are eliminated (i.e., $R_A^B = R^B$). 1/ Using equation (23), we obtain the new relationship between real after-tax interest rates that will equalize returns for residents of country B: 2/

$$(24) \quad r_a^* = (r_b^* + \pi_b)(1-t_a)(1-t_b)^{-1} - \pi_a$$

By substituting equation (24) into equations (20) or (21) we obtain $e = 0$ in both equations. Substituting equation (24) into equation (1) and using equations (14) and (15), we observe that when $e = 0$ parity conditions are maintained in both countries. This result indicates that, under differential taxation and differential treatment of interest and exchange gains, interest parity in both countries is only consistent with a constant exchange rate and therefore it requires equality of nominal rates of interest. When inflation rates differ, equalization of nominal rates is attained by changes in the after-tax real rates, which are brought about by international capital flows. This mechanism of equalization of nominal interest rates through capital mobility has a number of implications. For example, an acceleration in country A's inflation induces a capital inflow unto country A, raising the real interest rate in the second country and reducing its own real rate. Such an effect will be magnified by increases in the tax rate of the inflationary country.

c. Tax evasion on exchange gains

The results obtained in Section b are based on the assumption that both countries discriminate, in their tax treatment, between interest income and the value changes arising from exchange fluctuations. It can be shown that similar qualitative results arise from the alternative assumption that exchange variations and interest income are formally taxed at the same rate within each country, but, while tax deductions for foreign exchange losses are fully claimed, the effective tax rate on exchange gains is much lower (or zero) because of the widespread incidence of tax evasion. This assumption imposes an additional asymmetry on the system, one between devaluing and revaluing countries, which, although not arising from legal considerations, appears to be an economic fact widely observed in practice.

1/ Notice that, if $\pi_b > [(t_a-t_b)r_j^* + (1-t_b)\pi_a](1-t_a)^{-1}$, the exchange rate adjustment implied by equation (20) will induce capital imports from country A into country B. This type of capital flow will tend to widen the differential in relative returns, giving rise to the possibilities of an unstable result. Therefore, from stability considerations, that case should be ruled out.

2/ When real rates differ across countries, equation (23) becomes

$$(23') \quad R_A^B - R^B = (t_a-t_b)[(r_a^*+\pi_a)(1-t_a)^{-1} - (r_b^* + \pi_b)(1-t_b)^{-1}]$$

With this assumption, interest parity conditions, as expressed by equations (3) and (4), result in

$$(25)\quad i_A(1-t_a) = i_b(1-t_a) + e(1-\lambda t_a)$$

$$(26)\quad i_B(1-t_b) = i_a(1-t_b) + e(1-\lambda t_b)$$

where

$\lambda = 1$ for $e < 0$

$\lambda = 0$ for $e > 0$

Imposing purchasing power parity and using equations (1) and (2), the differential in returns within each country between domestic and foreign bonds becomes 1/

$$(27)\quad R^A - R^A_B = [(1-t_b)r^*_a - (1-t_a)r^*_b](1-t_b)^{-1} + \pi_a - (1-t_a)(1-t_b)^{-1}\pi_b$$

$$(28)\quad R^B_A - R^B = [(1-t_b)r^*_a - (1-t_a)r^*_b](1-t_a)^{-1} + (t_a-t_b)(1-t_a)^{-1}\pi_a + t_b(\pi_a-\pi_b)$$

Again, as under previous assumptions, purchasing power parity and the presence of taxation result in incentives for two-way capital flows and changes in the real rates of interest. If inflation rates differ, this result will emerge even if $t_a = t_b$. Consider the case where $\pi_a > \pi_b$. From equations (27) and (28), we observe that capital will flow from country B to country A and the real after-tax interest rate in the high-inflation country will therefore tend to fall. The differential in real rates that will restore portfolio equilibrium in country A is equal to the rate of devaluation:

$$(29)\quad r^*_b - r^*_a = \pi_a - \pi_b = e$$

This differential, however, provides an incentive in country B for capital mobility in the opposite direction, since, by substituting into equation (28) the equilibrium condition for country A obtained in equation (29), we get

$$(30)\quad R^B_A - R^B = -(1-t_b)(\pi_a-\pi_b)$$

which implies $R^B > R^B_A$. Clearly, equilibrium will require capital flows in both directions, with a reduction in r^*_a and an increase in r^*_b smaller than implied by equation (29). This outcome will be strengthened if the high-inflation country also has a higher tax rate ($t_a > t_b$), but it can

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1/ Assuming $\pi_a > \pi_b$, or $e > 0$.

be offset by $t_b > t_a$. These results are similar to the ones obtained in Section b under full tax exemption of exchange gains and losses. 1/

3. Summary

The Fisher effect, purchasing power parity, and interest rate parity are equilibrium relationships that are taken to hold simultaneously in the absence of exogenous interferences. Taxation in the financial market constitutes one such interference, since it may introduce a wedge between the returns on domestic and foreign assets (when the various components of those assets are taxed differently) and/or between the returns of a given asset according to the residence of the holder (when taxation differs across countries). Therefore, taxation prevents, in many cases, the simultaneous emergence of the three basic propositions and induces departures from their conventional formulations. In this paper, we have considered the nature of these departures and have discussed their implications. The basic premise of the analysis is that the introduction of taxes induces portfolio shifts aimed at restoring equality between the returns on domestic and foreign assets. These shifts result in interest rate and exchange rate non-neutralities that can be traced to the types and the combinations of taxes used. Some of the conclusions obtained from the analysis can be summarized as follows:

a. Identical rates of taxation across countries will not prevent the emergence of non-neutralities when rates of inflation differ and interest income and exchange gains are taxed at the same rate. Differences in inflation rates (with equal tax rates across countries) do not result in international capital flows, with the consequent changes in real interest rates and/or in departures from purchasing power parity, only when exchange gains are not taxed at the same rate as interest income.

b. Differences in tax rates between countries are conducive to differentials in real after-tax rates of interest (except when the exchange rate can depart from purchasing power parity in order to maintain interest rate parity and equal taxation applies to interest income and exchange changes). In general, higher tax rates result in lower real interest rates, even if rates of inflation are identical.

c. Under purchasing power parity, increases in the rate of inflation of the high-tax country result in a capital inflow and in a reduction of its real rate of interest. If the increase in inflation is not matched by an equivalent increase in the other countries, the new equilibrium will induce two-way capital flows when exchange gains are taxed at a lower rate than interest income.

1/ It can also be shown that, as in the previous case, if the exchange rate adjusts in order to maintain interest parity, real after-tax interest rates will change so that $e = 0$ will be the only exchange rate change consistent with interest parity in both countries.

d. When the exchange rate is determined by interest parity, the departures from purchasing power parity and the variability of the exchange rate are proportional to the differences between tax rates. However, when exchange gains are not taxed, interest parity is consistent only with constant exchange rates, which implies equality of nominal interest rates. Such an equality in nominal rates is brought about by capital flows from the low-tax country to the high-tax country, with the consequent adjustment in real after-tax rates.

Although some of the conclusions obtained here are dependent on the assumptions made, it is clear that the introduction of tax considerations provides an additional dimension to the analysis of interest rate determination in an open economy. One of the aspects of that dimension relates to the relationships between domestic inflation and the real rate of interest. The effects of expected inflation on the real rate of interest were extensively analyzed in the context of a closed economy as arising from the domestic substitutions between real and nominal assets (the Mundell and Tobin effects). In an open economy, the presence of taxation appears to provide an additional rationale for the relationship between inflation and real rates, a rationale based on the response of capital flows to differential inflation, and the consequent relocation of the international capital stock.

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